

# 150 km AB-1 Target Altitude Revisited

Dan Lyons

May 10, 1996

## Can We Detect the Atmosphere at 150 km ?

---

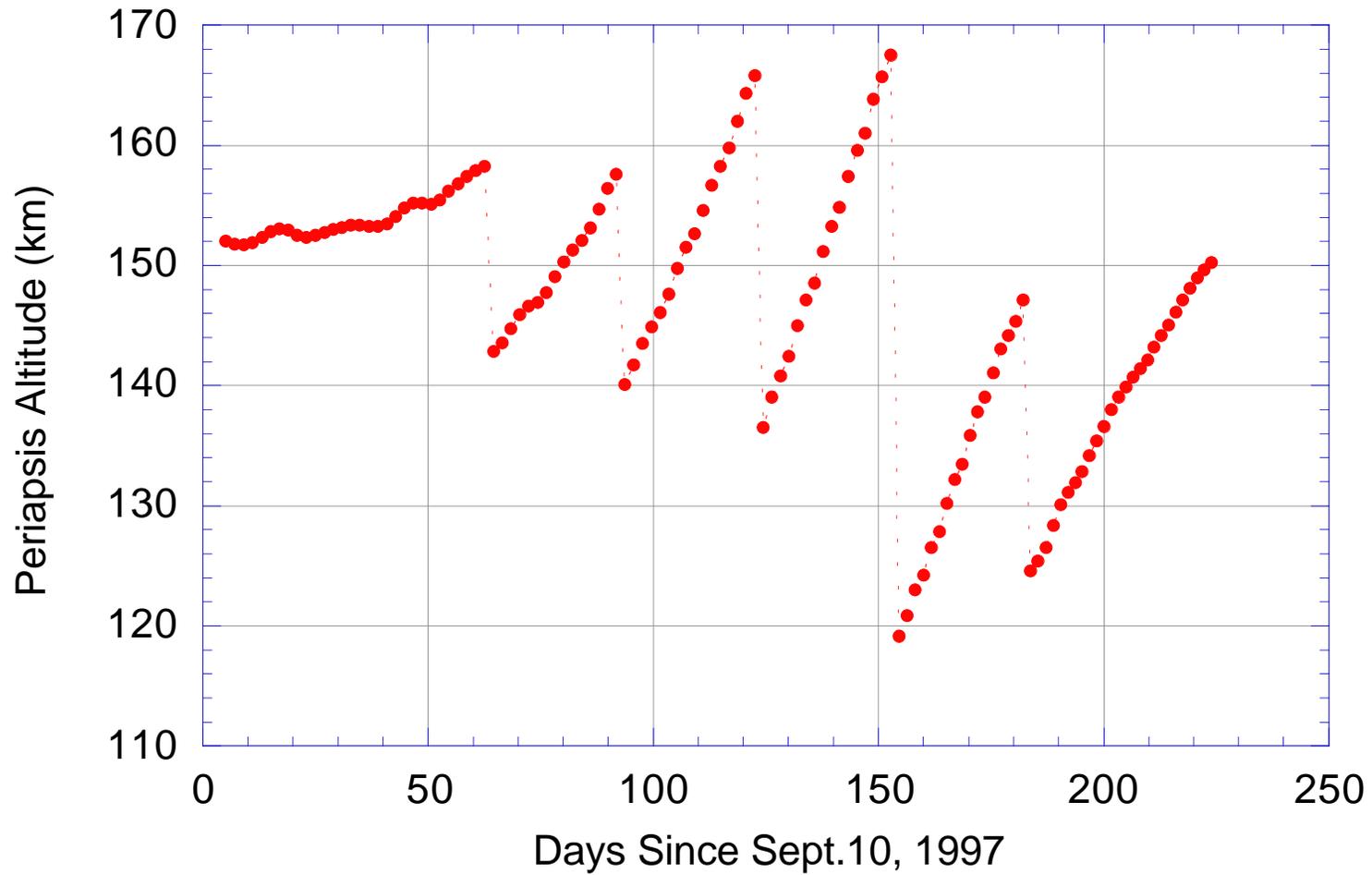
- One of the Questions from last weeks discussion related to the 150 km AB-1 altitude was whether we would be able to detect the atmosphere at 150 km.
- This presentation will show that we CAN detect an atmosphere equal to the nominal MarsGRAM densities at 150 km.
- If the density is greater than MarsGRAM predicts, the signal to noise in the measurement will be better, and we will be able to use the critical scale height approach for choosing the size of the next maneuver.
- If the density is so much less than expected as to be “Undetectable”, then we can perform the planned AB-2 without concern.

# APPROACH

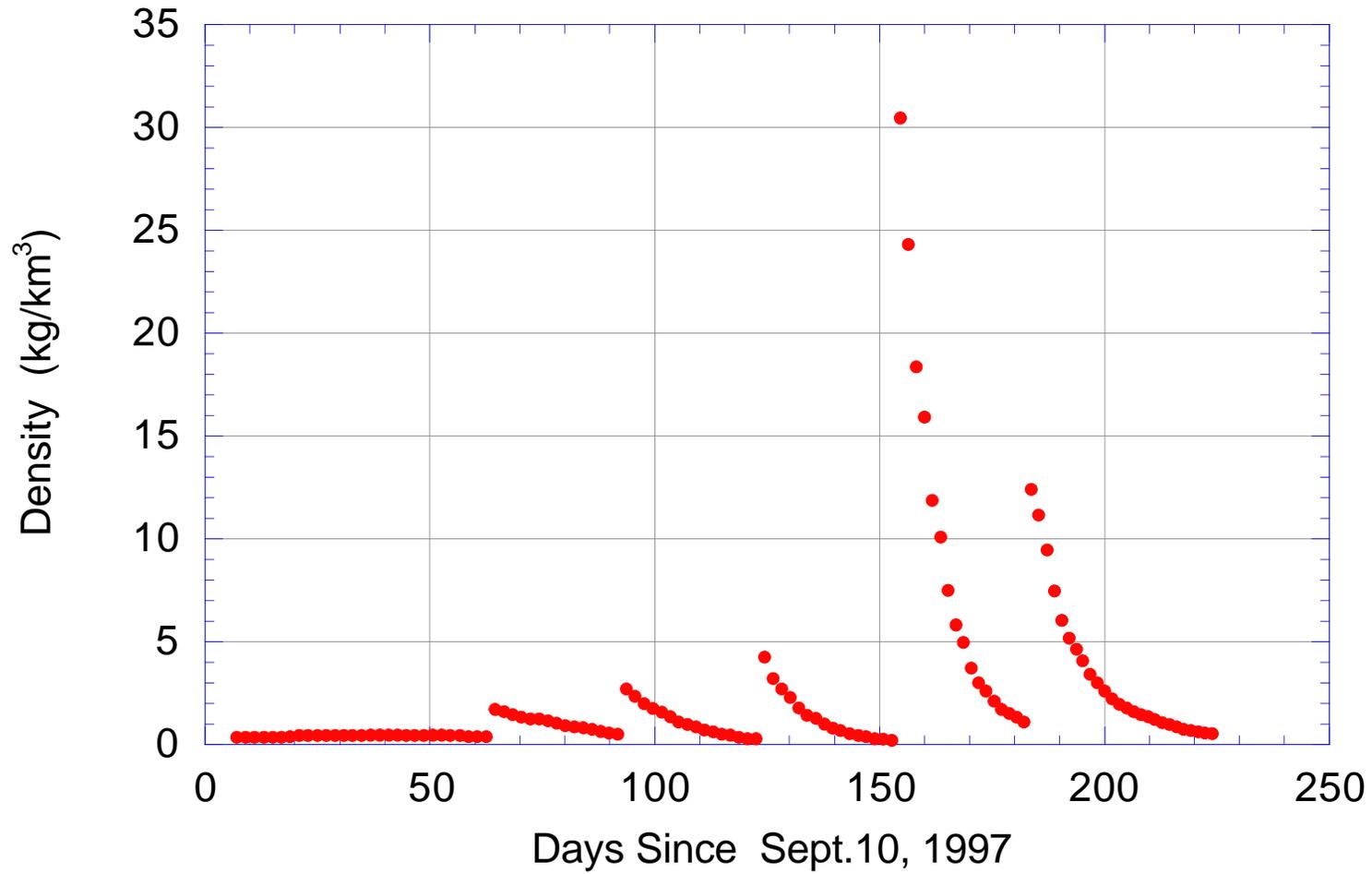
---

- Compute the Expected Period Change for Various Densities.
- Show that the Expected Period Change is Larger than the Measurement Accuracy from Nav or Accelerometers.
  - Nav Plan Quotes PREDICTION Accuracies < 5 seconds.
  - Magellan Period Reconstruction Accuracies < 1 second.
  - Accelerometer Quanta: 1 Count = 0.000332 m/s

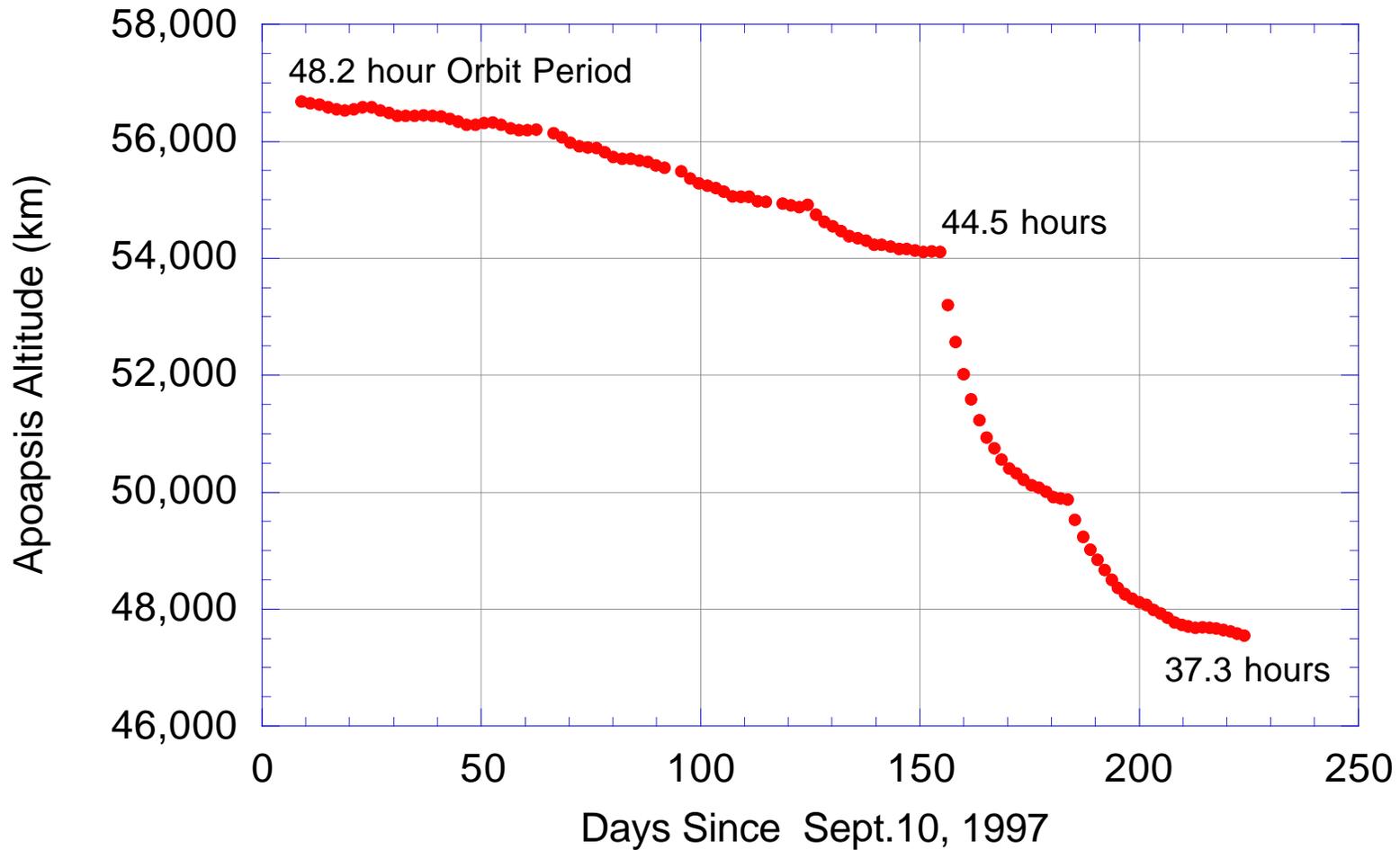
# THE DATA



# DENSITIES



# APOAPSIS DECAY

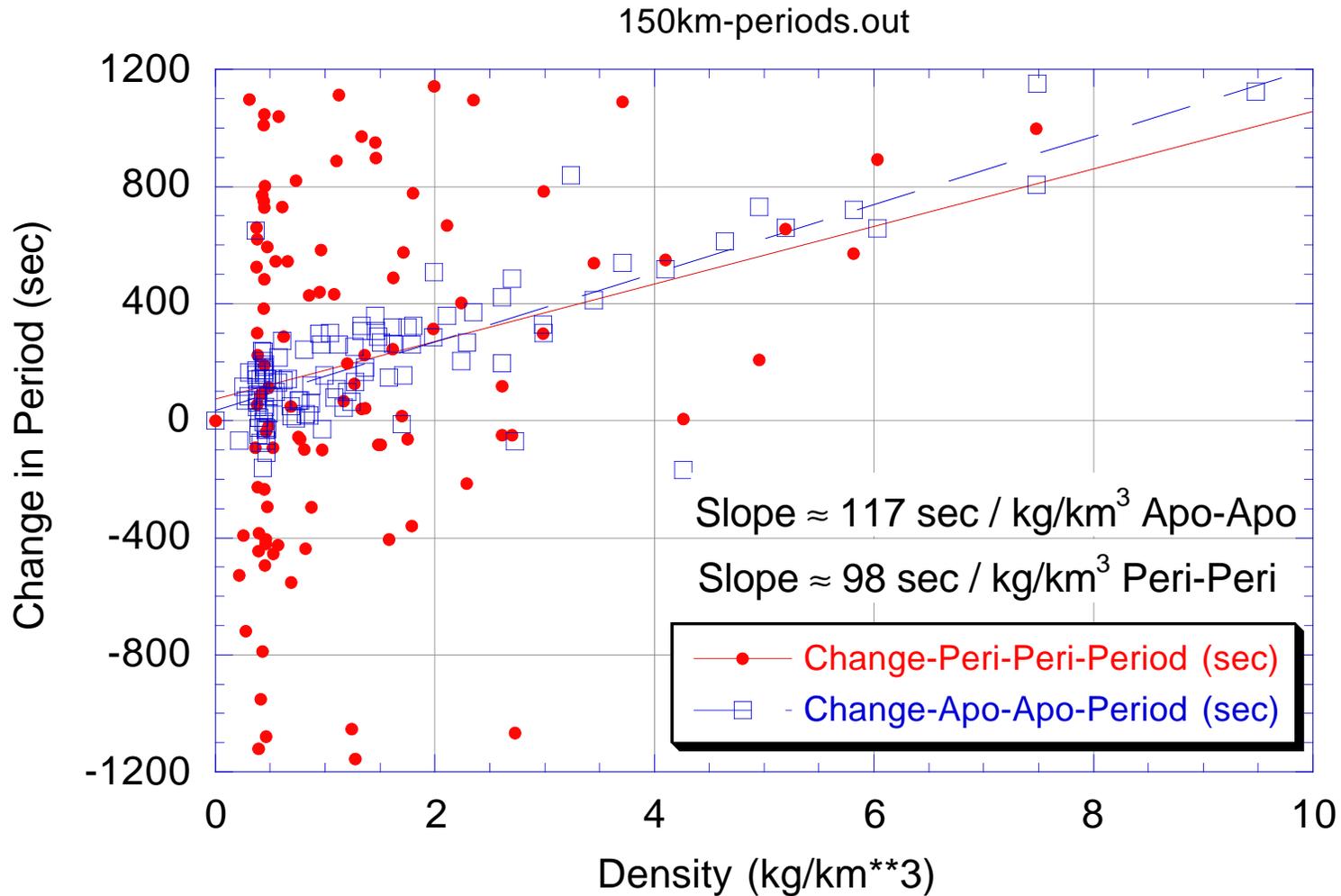


# CHANGE in PERIOD

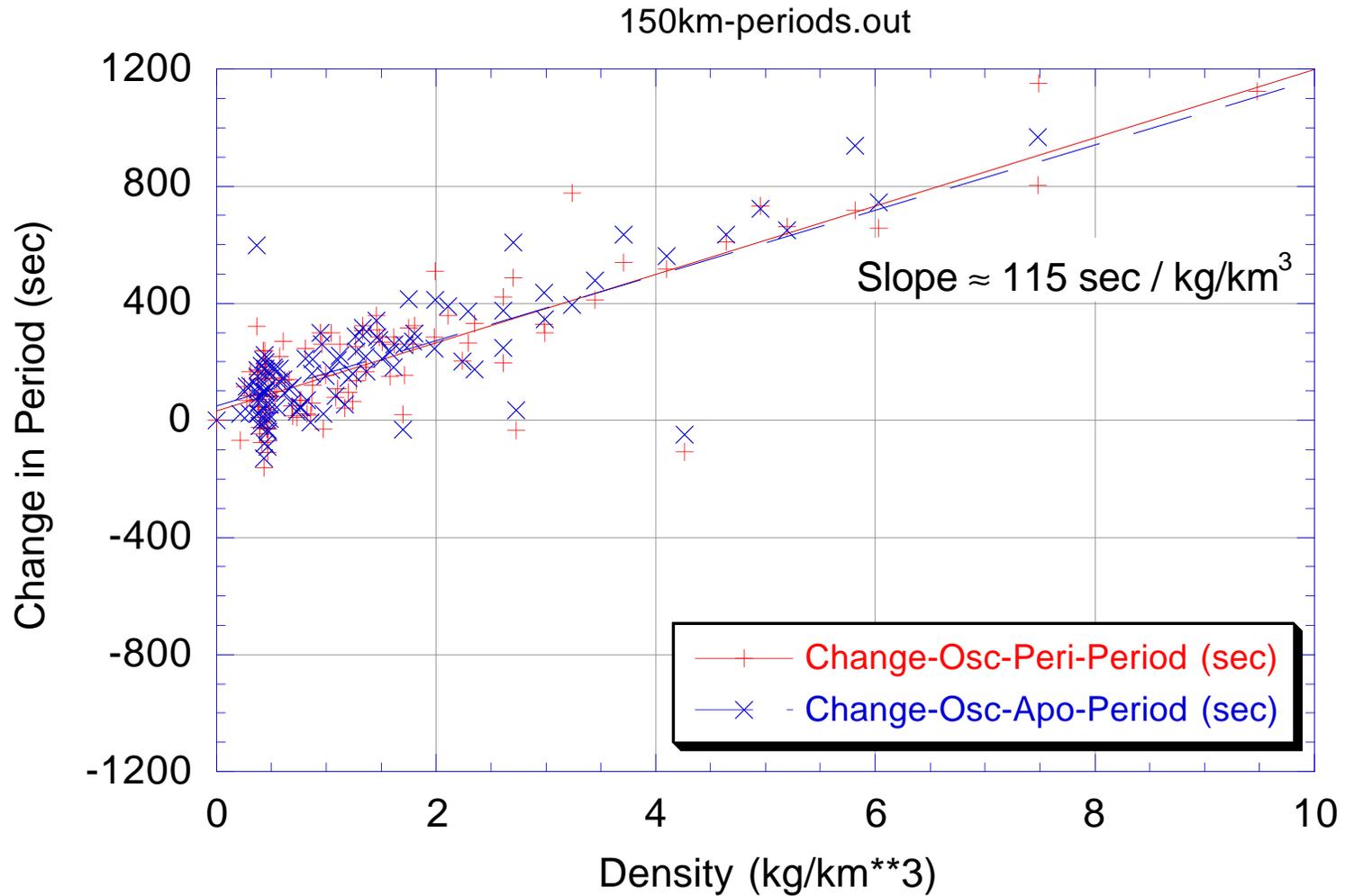
**Table 1: Methods for Computing the Change in Period**

Location	Computed Period	Description	#Peri.
PERIAPSIS	Osculating Period	Compute the Difference in Osculating periods at Periapsis, associate with the second periapsis.	2
PERIAPSIS	EPOCH - EPOCH (Worst Method) "Peri.-Peri"	The "Periods" = the differences in 3 consecutive Periapsis Epochs. Change in period = the differences in adjacent "periods".	3
APOAPSIS	Osculating Period (Best Method)	Compute the Difference in Osculating periods at Apoapsis, associate with the "middle" periapsis.	1
APOAPSIS	EPOCH - EPOCH "Apo.-Apo."	The "Periods" = the differences in 3 consecutive Apoapsis Epochs. Change in period = the differences in adjacent "periods".	2

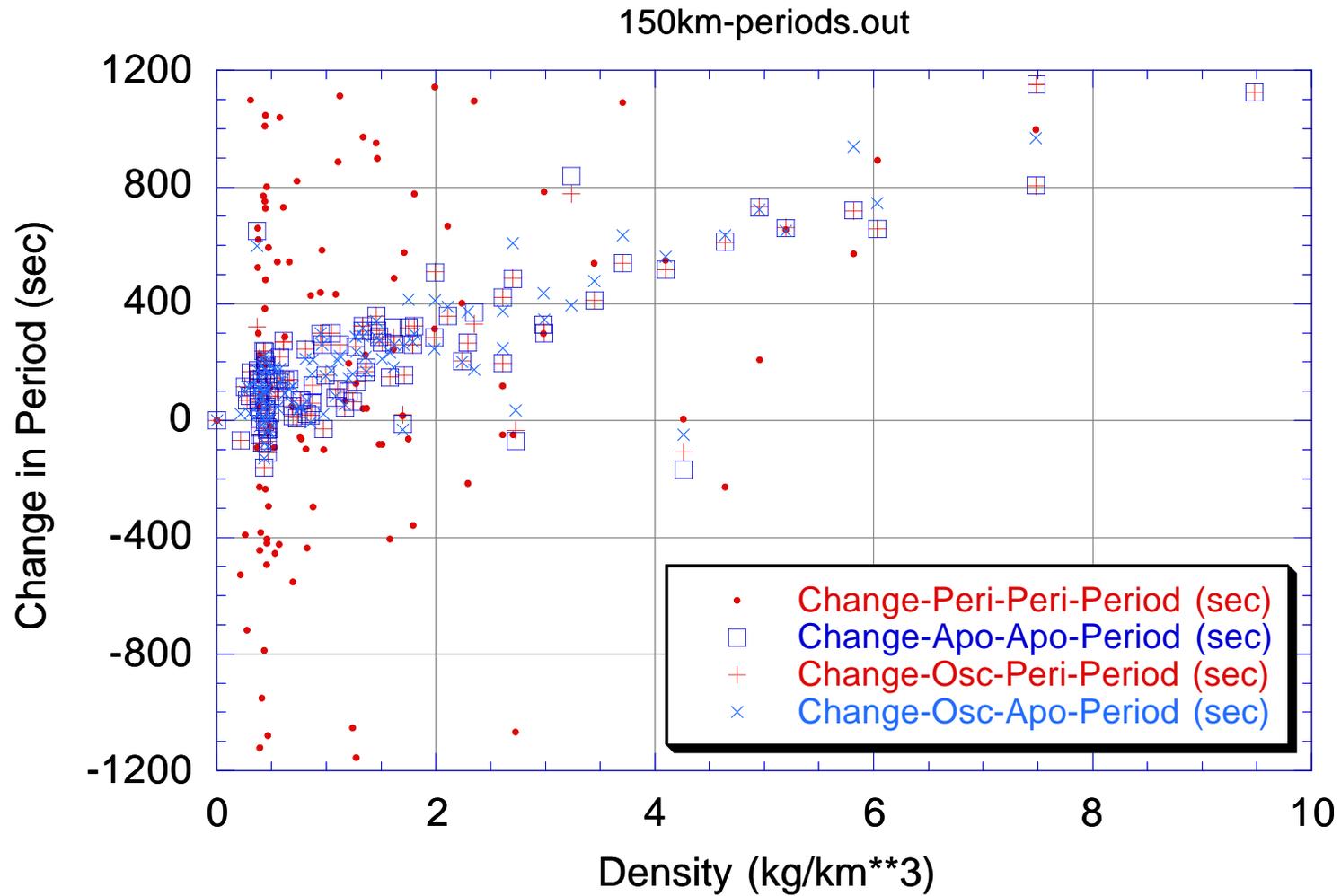
# EPOCH - EPOCH PERIOD



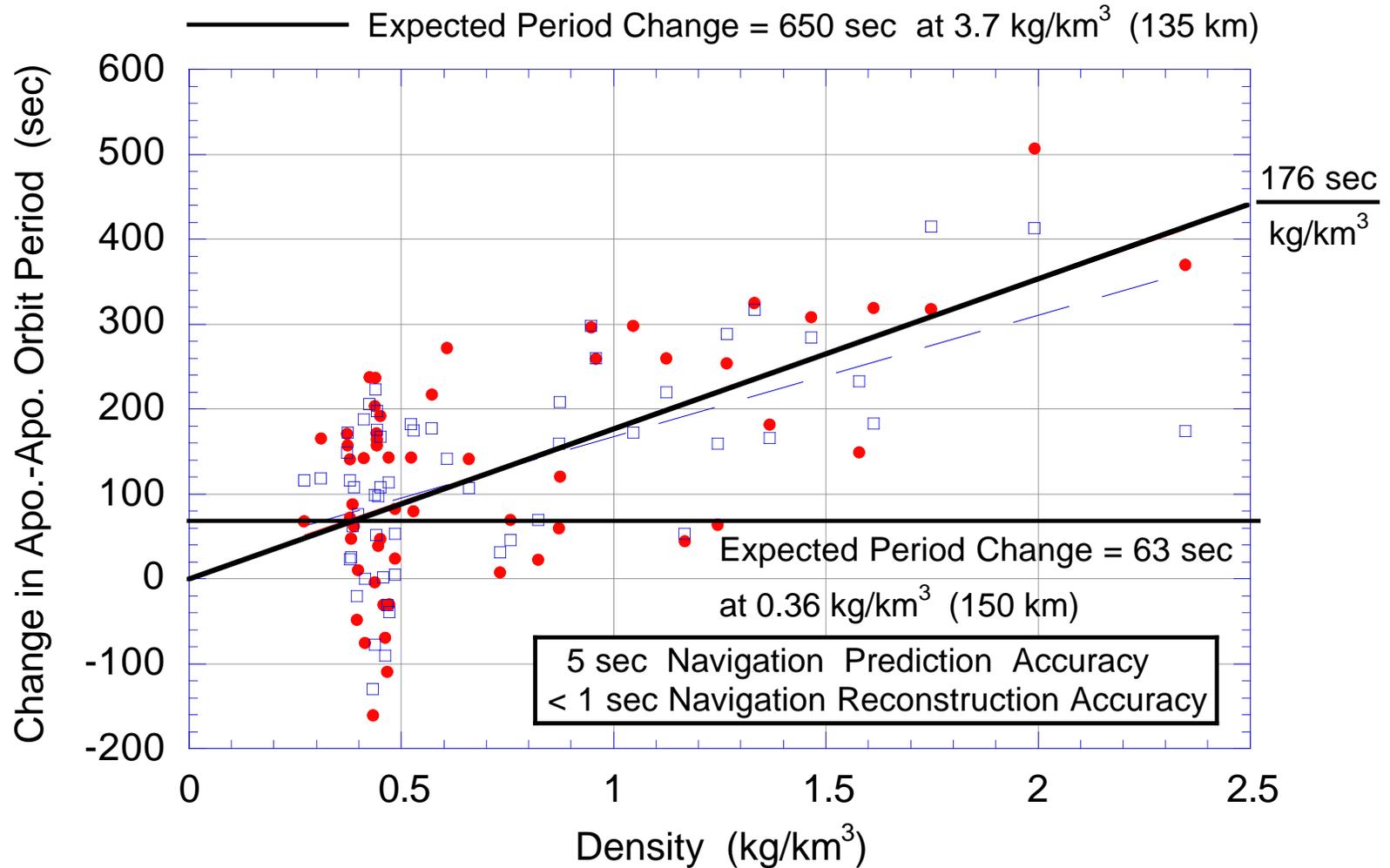
# OSCULATING PERIOD



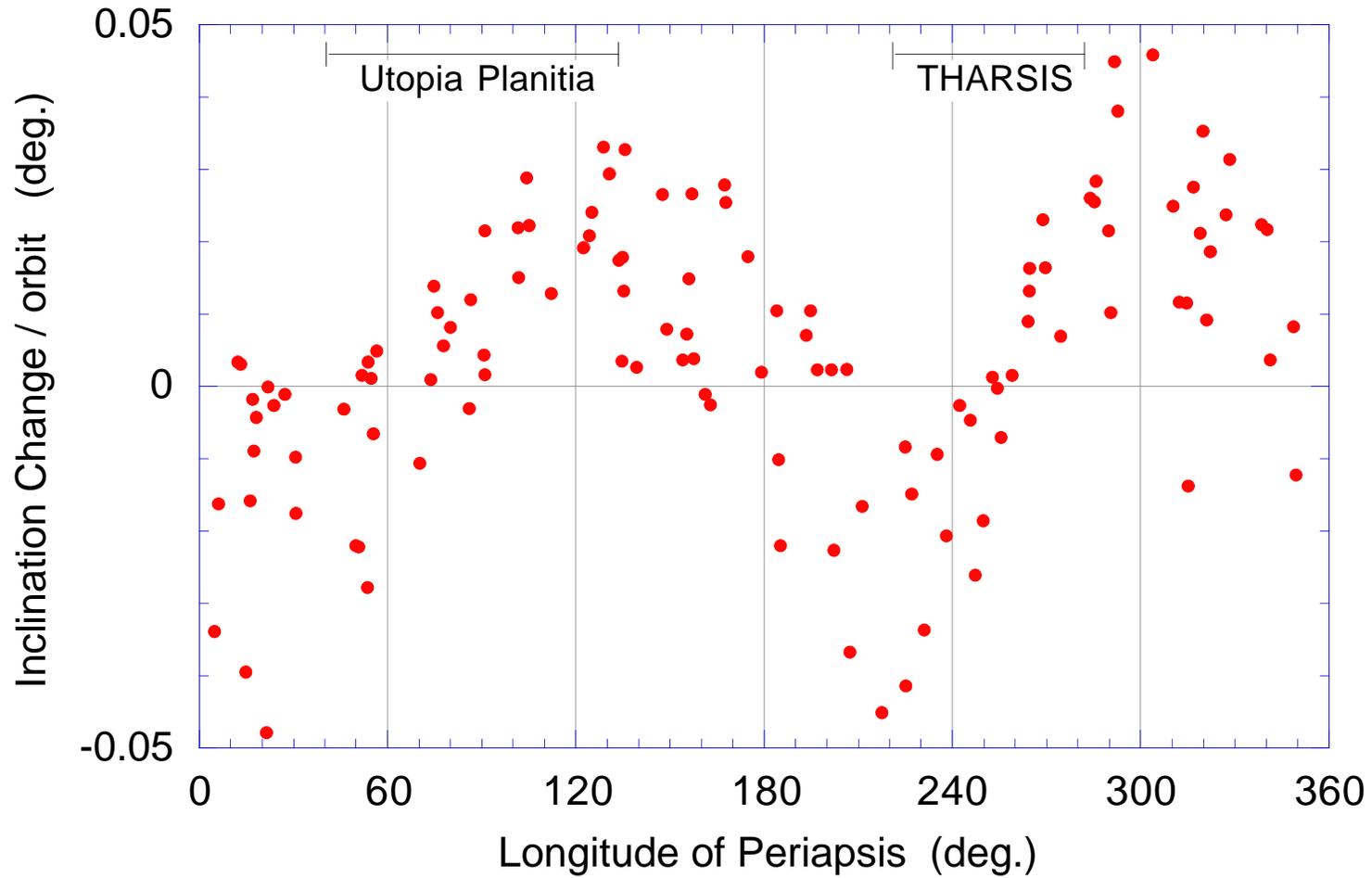
# All 4 Methods for Computing $\Delta$ Period



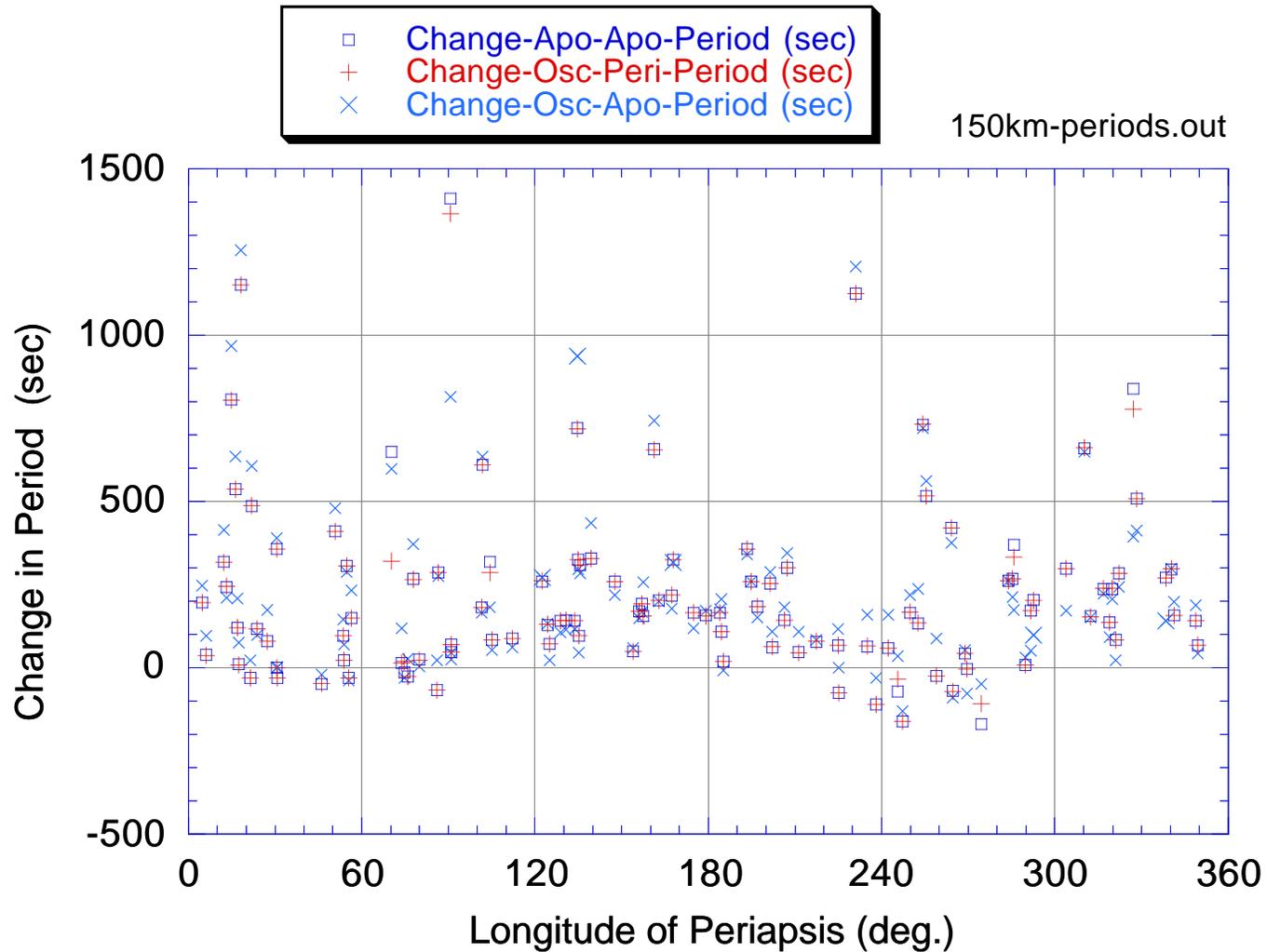
# NAV Capabilities vs Expected $\Delta$ Period



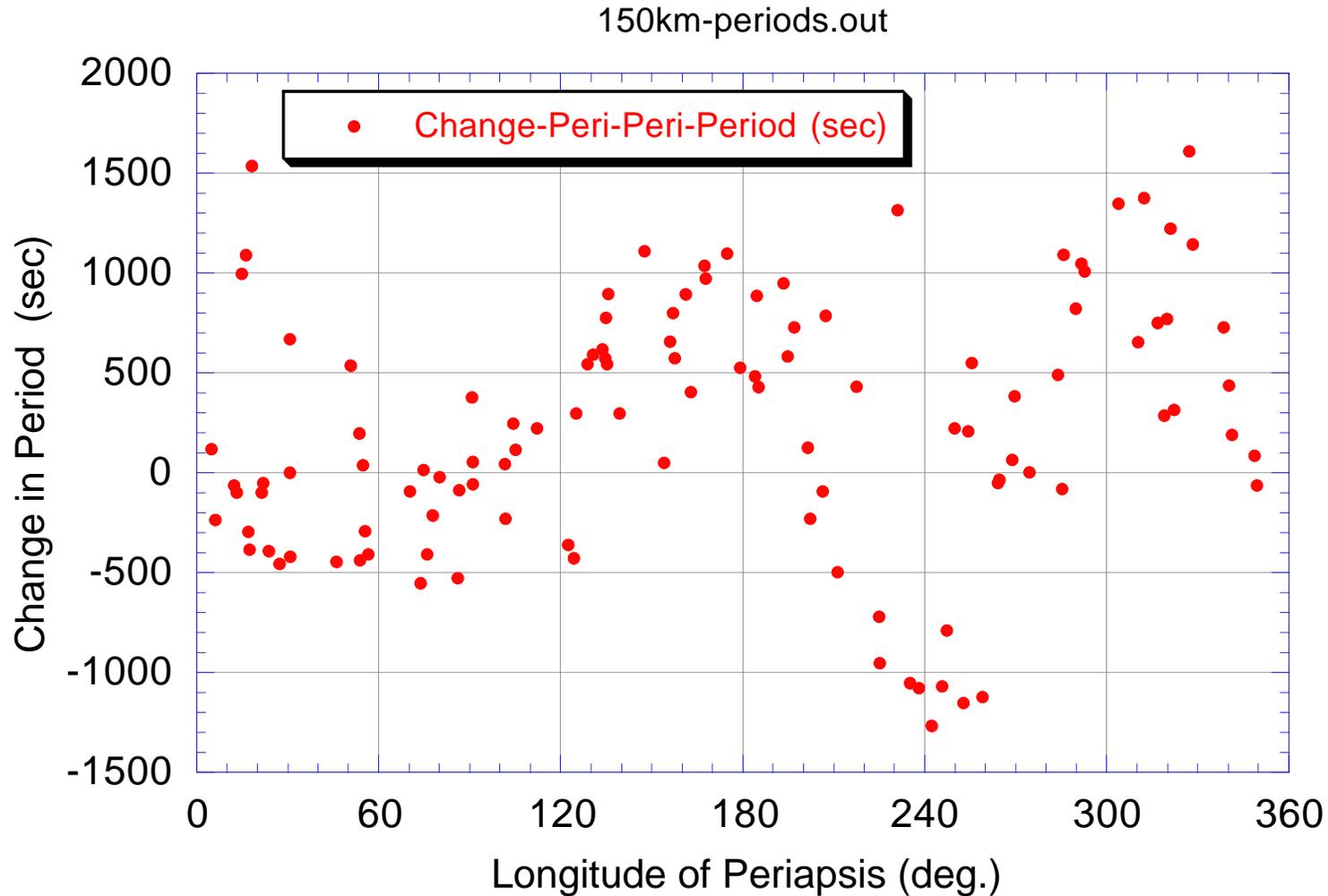
# GRAVITATIONAL PERTURBATIONS



# $\Delta$ PERIOD vs Longitude of Periapsis



# Periapsis - Periapsis $\Delta$ PERIOD vs. Longitude



# CONCLUSIONS

---

- Expected Period Change at 150 km  $\approx$  63 sec.
- Nav Can Reconstruct Period better than 1 sec.
  - Nav will be able to see a change in the orbit.
  - Back of the Envelope Calculations will be Dangerous.
    - Very sensitive to Gravitational Perturbations.
- Accelerometer should see  $> 100$  counts/ pass at 150 km.
  - 63 sec  $\Delta$ period = 0.034 m/s  $\Delta V$
- Larger than Expected Density means Better Signal to Noise.
- Smaller than Expected or “No” Density means use Planned AB-2.
- **150 km AB-1 is ACCEPTABLE.**
- Reminder: AB-1 to AB-3 on Consecutive Orbits is DESIRABLE.